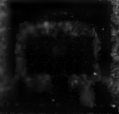
Technical Report No. 54 / Rapport technique n° 54

THE GOAL OF PRICE STABILITY:
A review of the issues

by
Jack Selody

Bank of Canada  Banque du Canada

May 1990

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The views expressed in this report are the responsibility of the author and do not necessarily reflect those of the Bank of Canada.

90-05565/

This report has benefited from the input of Denise Côté, Barry Cozier, Paul Fenton, Tim Fisher, Bob Ford, Danielle Forest, Rita Khemani, Hung-Hay Lau, Danielle Lecavalier, Patrice Muller, Serena Ng and Gerald Stuber. Bernard Bonin, Pierre Duguay, Paul Jenkins, Steve Poloz and David Rose provided helpful comments on the arguments and exposition. Maura Giuliani provided editorial advice. None of the above, however, should be held responsible for this report's final contents, which are solely my own responsibility.

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ABSTRACT

The basic responsibility of a central bank is to preserve the value of money — that is, to maintain stability in the general level of prices. This report pulls together the main arguments for and against price stability as the appropriate goal for monetary policy. The available evidence suggests that the benefits of price stability are many and large while the costs of getting there are transitory and small by comparison. Areas requiring further research are identified. The report also addresses the transition to price stability and the practical definition of price stability. It is illustrated that progress towards price stability is easier when wages and prices are flexible and when the monetary authority has credibility.

RÉSUMÉ

La responsabilité fondamentale d'une banque centrale est le maintien de la valeur de l'unité monétaire, c'est-à-dire la stabilité du niveau général des prix. Ce rapport rassemble les arguments favorables et défavorables au choix de la stabilité des prix comme objectif opportun de la politique monétaire. Les résultats de diverses études sur cette question laissent croire que les gains découlant de la stabilité des prix sont nombreux et élevés tandis que les coûts entraînés par la réalisation de cet objectif sont transitoires et faibles. Des questions requérant des recherches supplémentaires sont identifiées. Le présent rapport aborde aussi les questions de la transition vers la stabilité des prix et d'une définition pratique de la stabilité des prix. L'étude montre qu'il est plus facile de faire des progrès vers la stabilité des prix lorsque les salaires et les prix sont flexibles et les autorités monétaires sont dignes de crédibilité.

THE GOAL OF PRICE STABILITY: A review of the issues

1 INTRODUCTION

The basic responsibility of a central bank is to preserve the value of money — that is, to maintain stability in the general level of prices and thereby contribute in the best way possible to sustained good economic performance. A contemporary statement of the Bank of Canada's position on price stability can be found in Governor Crow's 1988 Hanson Lecture to the Uni ersity of Alberta.[1]

This report assembles the main arguments for and against general price stability as the appropriate goal for monetary policy. In many respects it is a complement to the recent study by the C.D. Howe Institute[2] which concluded that (i) monetary policy is properly directed at controlling inflation, (ii) inflation should be reduced from current levels, and (iii) the consumer price index provides a reasonably good measure of movements in the general price level. This report extends the C.D. Howe analysis in several important directions and identifies requirements for further research to quantify in a more precise way the permanent benefits of general price stability relative to the temporary costs of achieving this goal.

Section 2 reviews the rationale for general price stability as the appropriate goal for monetary policy rather than trying to hold inflation steady at an arbitrary level. Section 3 addresses the transition to price stability — issues not dealt with explicitly in the C.D. Howe study. Section 4 reviews the various measures of inflation and draws some tentative conclusions about how to define price stability.

It is important to note at the outset that general price stability does not mean that individual prices cannot change. Indeed, the efficient working of markets requires change in relative prices in response to shifting conditions of supply and demand. Moreover, the economy cannot operate properly unless prices are flexible. Nor does general

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[1] Reprinted in the *Bank of Canada Review*, February 1988.

[2] Richard G. Lipsey, (ed.), *Zero Inflation: The Goal of Price Stability*.

price stability mean that a particular aggregation of prices need remain fixed month after month, quarter after quarter and year after year. Price aggregates can change so long as the fluctuations are stable enough that expectations of ongoing inflation are not triggered.

2 PRICE STABILITY AS A GOAL

The basic case for general price stability rests on two propositions. The first is that the benefits of price stability — or, conversely, the costs of inflation — are many and large whereas the costs of attaining and maintaining price stability are transitory and small by comparison. The second proposition is that there is something special about price stability — namely, the absence of inflation. These propositions are examined in more detail below.

2.1 The costs of inflation

There are costs associated with inflation because money is an integral part of the exchange economy. Economists who see economic exchange as a non-monetary phenomenon, where goods are traded for goods, tend to ignore the distortions that inflation creates because they see money as a veil. As a result, inflation is perceived as having little consequence or cost.

But economic exchange is essentially a monetary phenomenon where goods and services are traded for money. Inflation matters because it obscures the value of money and therefore the value of the goods and services that money buys. As a result, in times of inflation, economic agents have a more difficult time planning, economic decisions are distorted and the economy operates less efficiently. Productivity, savings and investment all fall and, as a consequence, the potential of the economy to produce goods and services is lower.

What follows is a concise summary of the distortions that inflation causes in a monetary economy. More complete reviews of the theoretical and empirical literature on the costs of inflation can be found in any one of the papers by Howitt (1990), Fischer (1981), or Fischer and Modigliani (1978). Leijonhufvud (1980) provides an interesting non-traditional analysis of the costs of inflation, building on the concept of money as an institution.

The value of money

The main problem with inflation is that it erodes the purchasing power of money. The destruction of purchasing power caused by inflation can be dramatic, as Figure 2.1 illustrates — one dollar today will buy less than thirty per cent of what it could buy in 1970. At 5 per cent inflation, the dollar loses half of its purchasing power in only fourteen years.

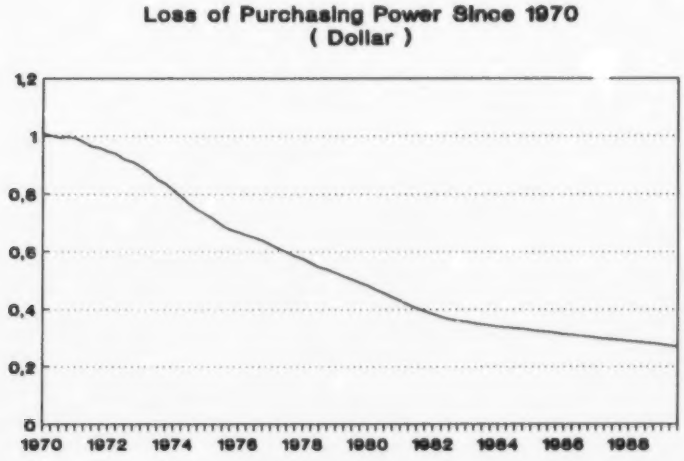

Figure 2.1

An anticipated decrease in the purchasing power of money imposes a direct cost on the economy because it causes economic agents to hold less money and therefore individuals 'spend more time in ATM line-ups' replenishing cash balances. Individuals also spend more time rearranging their portfolios to seek out the highest rate of return on their assets.

The reason that inflation causes economic agents to hold less cash is that it increases the opportunity cost of holding money through higher money interest rates. Interest rates rise with inflation because lenders demand compensation for reductions in the purchasing power of money, and borrowers provide this compensation without curbing their appetite for debt because they expect to repay with money that has lost its value. In effect, interest rates rise to reflect an inflation premium. When interest rates rise, people increase their holdings of assets bearing

interest payments and reduce their holdings of non-interest-bearing money.

Distortions produced by inflation and the tax system

Perhaps the largest distortions produced by inflation are related to the tax system.

The incentive to save is reduced by inflation because of higher tax rates on income and wealth. The money value of interest receipts are subject to taxation, despite the fact that in times of inflation large money interest receipts are necessary just to preserve the real value of an asset. Gilson (1984) also shows that the real tax rate on investment income rises with inflation because the tax system is not fully indexed.

Inflation can also interact with the tax system to magnify disincentives to work. This distortion arises because the income tax system is progressive. A progressive tax system is one where individuals in higher income brackets pay proportionately higher tax rates on each additional dollar of income. Inflation pushes individuals into higher brackets, causing them to pay more taxes when the divisions between income brackets are not fully indexed. This effect is probably of secondary importance in Canada at the present time, since there are only three tax brackets and these are indexed for inflation in excess of three per cent.

The cost of capital tends to increase because of inflation which reduces the incentive to invest. Depreciation allowances for tax purposes are calculated on an historic cost basis such that the total depreciation allowance over the life of a machine is equal to its original cost. Depreciation allowances thus understate the cost of replacing worn-out machinery in times of inflation because the true cost of replacing the machine is rising with inflation. In other words, the true cost of replacing capital is greater than that recognized by the tax system.

Investment is allocated inefficiently in times of inflation because all assets are not treated equivalently by the tax system. The capital gain on an owner-occupied house is tax exempt, for example, whereas capital gains on most other assets are taxable. Inflation compounds this disparity because it is the money value of capital gains that is subject to taxation. The net result is that individuals will be more inclined to

make investment decisions on the basis of tax considerations, which may divert economic resources away from their most productive use.

The financial fragility of firms increases in times of inflation in part because the tax system treats interest payments on business loans as a taxable expense, increasing the attractiveness of borrowing relative to that of issuing new equity. With greater debt, firms are more susceptible to economic swings when cash flow may not cover interest on the debt. Cash flow is further constrained because firms are repaying debt at accelerated rates because interest payments have a built-in inflation premium. This increased fragility of firms will tend to amplify the consequences of variations in business conditions.

Thus, inflation and the tax system conspire to create distortions that not only reduce incentives to save and invest, but encourage individuals to make saving and investment decisions on the basis of tax considerations. With less and distorted saving and investment, the future productive capacity of the economy suffers.

Distortions that affect productivity

Inflation imposes other indirect costs on the economy. Perhaps the most damaging of these is the effect that inflation has on productivity by way of distorting market information. In a market economy, a relative price increase provides an important resource allocation role in signalling firms to produce more of that good. But inflation severely inhibits this function of prices because, with inflation, firms may not know whether a price increase is specific to their product or general to all goods and services. Firms must therefore spend time and resources determining whether a price increase is signalling a genuine increase in demand in their market, a relative price change, or whether it simply reflects a general increase in prices. Inevitably mistakes will be made, resulting in a misallocation of resources. Milton Friedman (1986), among others, judges this loss of information to be the most serious consequence of inflation.

Another reason that productivity suffers in times of inflation is that firms incur costs when changing prices (costs associated with the decision-making process and with the diffusion of information). These costs are higher when inflation is high because prices must be changed

more frequently. Resources must be diverted to changing prices, and productivity suffers.

As a consequence of costly price adjustment, firms change prices only periodically, and even then not in unison, so that relative prices get distorted. The greater the inflation the greater the distortion in relative prices. Distortions in relative prices cause resource misallocation because relative prices no longer reflect opportunity costs but other, less fundamental, considerations.

In addition to resource misallocation, consumers probably know that relative prices are likely to be distorted by inflation and therefore spend more time comparison shopping and bargain hunting. Even for a particular product, consumers must search because different suppliers may be at different points in the pricing cycle, and particular suppliers may have different prices for the same product on their shelves.

Inflation also reduces productivity because it creates uncertainty that interferes with negotiations about wage and salary contracts set in money terms. This uncertainty diverts resources away from production as negotiations become more complex and are undertaken more often. Frequent negotiations provide more opportunity for disagreement between negotiating parties, with the result that strikes and other productivity-reducing disruptions to work become more widespread. Strike activity tends to be more volatile and higher on average when inflation is high. This was especially true in the early 1970s, when the increase in inflation was largely unanticipated. A positive correlation between strike activity and inflation can be seen in Figure 2.2 and is also detected in some of the studies surveyed by Lacroix and Dussault (1979).

Inflation also reduces productivity because it gives rise to a sophisticated financial 'advice' industry that counsels individuals on how to protect the real value of their assets. The resources used by this industry are diverted from more productive endeavours and therefore aggregate productivity is diminished.

Inflation affects productivity through saving and investment decisions by adding to uncertainty about the future value of assets. This uncertainty can put upward pressure on interest rates if risk-averse savers demand larger risk premiums to compensate for the greater risk. Savers could

Figure 2.2

also tend to favour shorter-term financial assets in times of greater uncertainty since the expected return on long-term assets is even more uncertain than that on short-term assets. Borrowers could therefore be forced to pay a premium to borrow for long terms.

A second consequence of the uncertainty created by inflation is a reduction in the planning horizon of firms. This effect, combined with the fact that inflation distorts financial data, can cause firms to make serious errors in investment decisions. Indeed, it has been suggested that the excessive borrowing by developing countries and by firms operating in the energy sector in the late 1970s was related to the inflationary environment of the time.

2.2 Benefits versus costs of reducing inflation

It is generally accepted that the benefits of price stability are lasting whereas the costs incurred in reducing inflation are transitory. For this reason, the present discounted value of the benefits of price stability exceeds the costs of getting there. This point has been made by Feldstein (1979), by Meyer and Rasche (1980), as well as by others. Howitt (1990), in a rare attempt to quantify the costs and benefits of lower inflation in Canada, finds that the present discounted value of benefits exceeds costs by an order of magnitude.

To calculate the yearly gain in gross domestic product (GDP) that could be expected to emanate from lower inflation, it is necessary to make assumptions about whether inflation affects the level of GDP or its growth rate. The available empirical evidence on this point is somewhat ambiguous. Howitt (1990) assumes that inflation affects the *level* of GDP and estimates that each percentage-point reduction in inflation will increase GDP permanently by 1.875 per cent per year (*assumption 1*). It should thus take about 0.53 years (just over six months) for the economy to produce enough extra output with lower inflation to replace one per cent of GDP.[3]

Jarrett and Selody (1982), in contrast, presume that inflation affects the *growth rate* of GDP and estimate that a one percentage-point reduction in inflation causes GDP to grow three tenths of a percentage point faster as a result of higher productivity growth (*assumption 2*).[4] This estimate of the benefit of lower inflation is smaller than Howitt's in the years immediately after the reduction in inflation, but the benefit grows through time so that eventually it is much larger. Nevertheless, according to this estimate it takes about 2.5 years for the economy to produce enough extra output to replace one per cent of GDP.[5]

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[3] I.e., the inverse of 1.875 is 0.53. Note that the benefits of lower inflation are fully realized only after it is clear to economic agents that inflation is permanently lower. According to Purvis (1990), it may be as long as five years after the start of an anti-inflation policy before prices have fully adjusted to restrictive monetary policy. Thus, there will most likely be some delay before the payback period starts.

[4] Novin (1990) extends the Jarrett and Selody sample to include the 1980s and controls for changes in relative factor costs. He obtains estimates of the effect of inflation on productivity growth similar to those obtained by Jarrett and Selody.

[5] The equation used to derive the payback ratio in this case is:

$$C = \{\text{integral}[0,T] \text{ of } \exp((g+x)t)\} - \{\text{integral}[0,T] \text{ of } \exp(gt)\},$$

where T is the payback period,
C is the cost of reducing inflation (the sacrifice ratio),
x is the gain from lower inflation (.003),
g is the potential growth rate of the economy (assumed to be .03), and
t is time.

The equation calculates how many years T it will take until an economy growing at g+x produces a cumulated amount C more than an economy growing at g. The equation reduces to

(continued...)

Traditional macroeconomic models suggest that an increase in the degree of slack in labour and product markets is required to reduce inflationary pressures. The amount of GDP foregone in reducing inflation by one percentage point is commonly referred to as the *sacrifice ratio*. Different economic assumptions lead to different estimates of the magnitude of this ratio. Howitt (1990), using data from the 1981-82 recession and subsequent recovery, estimates that the sacrifice ratio is 4.7 per cent of GDP (foregone for each percentage point reduction in inflation). He arrives at this estimate by assuming that all of the increase in the unemployment rate during and following the 1981-82 recession is attributable to monetary policy and therefore represents the cost of reducing inflation.

RDXF, the Bank of Canada's econometric model, produces an estimate of the sacrifice ratio that is lower than Howitt's. In RDXF, some of the increase in unemployment that occurred after 1981-82 recession is attributed to factors independent of monetary policy and therefore does not contribute to the cost of reducing inflation. RDXF predicts that a cumulated output gap of 3.4 per cent of GDP is required to reduce inflation by one percentage point.

An even lower sacrifice ratio is implied by the model estimated by Ford and Rose (1989). Ford and Rose estimate a Phillips curve, an Okun's Law equation, a production function and a NAIRU equation for two sample periods, 1967Q1-85Q4 and 1967Q1-81Q4.[6] Here, 2.6 per cent of GDP is sacrificed for each percentage point reduction in inflation, based on the average of estimates from the two sample periods.[7]

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[5](...continued)

$$C = (1/(g+x))\bullet\exp((g+x)\bullet T) - (1/g)\bullet\exp(g\bullet T) - (1/(g+x)) + (1/g) .$$

The payback periods reported in Table 2.1 under the heading Assumption 2 are calculated by solving this equation for different values of T, and then picking the value of T that corresponds most closely to the relevant value of C.

[6] Rose (1988) defines the NAIRU as the rate of unemployment consistent with unchanged inflation.

[7] Cozier and Wilkinson (1990) obtain a sacrifice ratio of 2 from an equation that relates inflation directly to output gaps.

But simply computing the value of the benefits and costs of lower inflation does not provide much information about how long it takes for costs to be recovered. Calculating this value is important, because the case for price stability is more compelling when costs are recovered quickly.

The *payback period* — that is, the length of time it takes to recover costs — provides information about how long one must wait for net positive benefits from price stability. Technically, the payback period is the GDP foregone in reducing inflation divided by the yearly gain in GDP from having inflation at the lower level.

Based on assumption 1 above — where it takes 0.53 years of lower inflation to produce enough extra output to replace one per cent of GDP — it takes 2.5 years to pay back Howitt's 4.7 per cent of GDP lost in reducing inflation (i.e., 0.53 times 4.7). Based on assumption 2, where lower inflation results in higher growth, it takes 5.3 years to pay back 4.7 per cent of GDP. Under assumption 2, the benefits from price stability are small initially, but grow indefinitely as a proportion of GDP, so that the present discounted value of the benefits is incommensurate with the once-off short-term cost of reducing inflation.

Table 2.1 lists the estimates of sacrifice ratios and payback periods from the economic models discussed above. In no case is the payback period longer than six years, and under one set of assumptions is as short as a year and a half.

Table 2.1

Foregone Output from Reducing Inflation by one Percentage Point
Estimates using different economic assumptions

Calculation From	Sacrifice Ratio	Payback Period (years)	
		Assumption 1	Assumption 2
Howitt (1981-82 recession)	4.7	2.5	5.3
RDXF	3.4	1.8	4.5
Ford and Rose	2.6	1.4	4.0

Finally, note how small the yearly benefits of lower inflation are in comparison to the costs of reducing inflation. It would thus be easy to

undervalue the benefits of price stability while overvaluing the costs of reducing inflation, especially since the benefits accrue only after the costs have been paid. But the benefits of lower inflation cumulate whereas the costs do not. In other words, a reduction in inflation has short-term costs but produces net ongoing benefits, exactly the opposite of higher inflation, that may stimulate the economy in the short run but comprises a net ongoing burden to the economy.

2.3 Arguments against price stability

Arguments against price stability tend to take two forms. The first is that traditional macroeconomic models understate the true costs of reducing inflation because they ignore the effects of (i) hysteresis, (ii) the lack of credibility of the goal of price stability, (iii) the asymmetric effects of shocks, and (iv) distributional effects. The second argument is that positive inflation provides benefits to the economy not captured by these models. These benefits derive from the notion that inflation can be used as a tax on wealth and from the notion that there might be a long-run trade-off between inflation and unemployment. Each of these arguments is examined below.

Hysteresis

The basic idea behind hysteresis is that where the economy goes depends on the path taken to get there. In other words, hysteresis starts with the presumption that the economy has multiple equilibria. The version of hysteresis popularized by Blanchard and Summers (1986), for example, supposes that there are multiple equilibrium rates of unemployment because workers tend to lose their job skills during long layoffs and therefore become unemployable. In effect, the human capital of workers depreciates during long periods of inactivity. Any move to price stability that triggers a protracted slowdown in activity could therefore push the economy into a high unemployment equilibrium that would add significantly to the costs of attaining price stability. This could explain, for example, why Canadian unemployment was slow to decline following the 1981-82 recession. Mild fluctuations in economic activity, where the duration of unemployment is short, are presumed to have no effect on the equilibrium rate of unemployment.

There is not much empirical evidence to support the view that hysteresis is a factor in the Canadian economy. Fortin (1989) reports evidence of hysteresis, finding that the change in the unemployment rate, not its absolute level, influences the inflation rate. If this result stands up to close scrutiny it would mean that a permanent reduction in inflation can be achieved only at the expense of a permanent increase in the unemployment rate.

Variations in Canadian inflation and unemployment since the 1981-82 recession do not seem to concur with Fortin's results. In the recession, the unemployment rate increased from 7 per cent in 1981 (a level below the NAIRU) to 12 per cent in 1983 and inflation fell from 12 per cent in 1981 to about 5 per cent in 1984. By the middle of 1989, the unemployment rate was again just below estimates of NAIRU yet inflation had remained around 5 per cent. Fortin's model would have predicted a return of inflation to the neighbourhood of 12 per cent.

Rose (1988) provides an alternative explanation of why unemployment remained high for so long after the 1981-82 recession. He focusses on factors other than the recession in explaining the high unemployment rates through the post-recession period, factors that are independent of the effects of monetary policy. The factors identified by Rose are: (i) regional imbalances caused by a combination of relative price movements and the effects of regionally extended unemployment insurance benefits; (ii) a rising ratio of UI benefits to the industrial wage; and (iii) the combined effects of rising female participation rates and the lingering problem of absorbing the 'baby boom' cohort into the labour force.

Work by Coe (1990) and Burns (1990) also supports the view that hysteresis effects are less important than structural factors in explaining the Canadian natural rate of unemployment through the post-recession period.[8] Similarly, tests by McCallum (1988) reject the hypothesis of hysteresis, as do tests by Cozier and Wilkinson (1990). Nevertheless, further work is required on the question of hysteresis.

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[8] Coe finds that the generosity of the unemployment system has been largely responsible for changes in the NAIRU in Canada. Burns finds that the relative price of energy makes the largest contribution to changes in the NAIRU in the post-recession period.

In any event, the argument for hysteresis is not so much an argument for positive inflation as an argument against rapid, unannounced moves to price stability. A gradual move to price stability, for example, should avoid the severe slowdowns in economic activity that have the potential for creating permanently higher rates of unemployment.[9]

A second reason why traditional analysis, by ignoring the possibility of multiple equilibria, might understate the costs of attaining price stability is that the high interest rates necessary to achieve price stability might delay investment indefinitely. Economic potential, therefore, could be reduced. The argument insinuates that high interest rates are particularly damaging at present because business is in the middle of a drive to modernize.

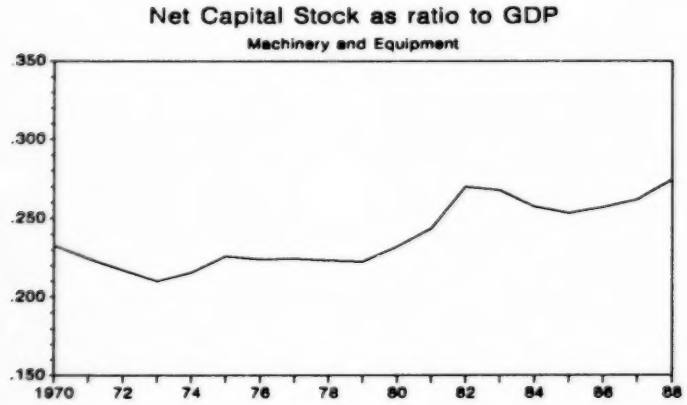

Figure 2.3

There is little empirical evidence, however, to support the view that temporary increases in interest rates do in fact cause permanent reductions in the capital stock. Figure 2.3, for example, shows that significant capital accumulation in machinery and equipment has taken place since the early 1980s despite real interest rates that are high by historical standards. Moreover, investment in all types of capital has been strong in recent years, with aggregate real business investment

[9] This point is made by Purvis (1990).

growing at 22 per cent in 1987, 12.3 per cent in 1988, and 9.5 per cent in 1989. In other words, business is continuing to expand its capital base despite what may appear to be high interest rates.[10]

A third argument that uses the existence of multiple equilibria to defend positive inflation cautions that an appreciation of the Canadian dollar might nullify the 'once-in-a-lifetime window of opportunity' that the free trade agreement provides. The argument here is that a high value for the Canadian dollar will stop firms from locating in Canada, and therefore the benefits from the free trade agreement will accrue to the Americans.

The counter argument is that price stability will complement the free trade agreement in attracting investment to Canada because it provides firms with a stable environment in which to make long-term investment plans. Moreover, any appreciation of the *real* exchange rate caused by tight monetary policy will be temporary.[11] Firms, therefore, should see through the appreciation and not allow it to influence their decisions about where to locate production, especially since the transition to free trade itself is spread over ten years. And finally, the free trade agreement will make firms more profitable as they use resources more efficiently because of product rationalization. This increased profitability will help offset the effects of the temporary appreciation of the real exchange rate.

Credibility

Central bank credibility has an important influence on the transitional costs of establishing and maintaining an inflation target — the more credible a target, the lower the costs incurred in getting there. When a target lacks credibility, the costs of attaining it can be high.

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[10] One reason why investment has been so strong is that the rental cost of capital goods has been declining. Since the beginning of 1981, for example, the national accounts price index for machinery and equipment has fallen 10 per cent.

[11] Part of this argument against price stability comes from a confusion between the appreciation of the exchange rate necessary to reduce inflation and the appreciation that Canada experienced in 1987-88 that was due in large part to shifts in Canada's international terms of trade. See the *Bank of Canada Annual Report 1989*, p. 9, for a discussion of this issue.

The argument that the goal of price stability lacks credibility is based on the observation that few countries have ever attained price stability and that Canada has managed systematically to produce an inflation performance somewhat worse than that of its major trading partner. The reason that price stability is so rare, the argument goes, is that politicians and central bankers do not have the will to achieve and maintain price stability.

But there are reasons to believe that price stability is more credible than other goals of monetary policy. First, the countries with the most stable rates of inflation tend to be those with the lowest rates, suggesting that the closer an inflation target is to zero, the more credibility it has. Second, price stability has an inherent plausibility that is lacking in any other inflation target. This plausibility stems from the fact that price stability is the only goal that satisfies the basic mandate of a central bank — namely, to preserve the value of money. To quote Angell (1990), *"a central bank's announcement and attainment of a stable price level objective would resonate with the citizenry in a way that no other goal could."*

Nevertheless, it is reasonable to presume that credibility must be earned. Inflation targets may have some immediate credibility when announced because the monetary authority puts its reputation on the line in backing them. But, in general, credibility is earned only when it is clear that the target can and will be reached and maintained. In this respect, price stability is no more or less credible as a long-term goal than any other announced goal of monetary policy.

Asymmetries

Fortin (1990b) argues that traditional analysis understates the true cost of reducing inflation because the Phillips curve is probably non-linear at low rates of inflation, contrary to what is assumed in the traditional cost-benefit analysis of disinflation. In particular, he argues that disinflation is more costly at low rates of inflation because some workers will probably have to accept money wage cuts if inflation is to be reduced below a certain level. Since a cut in money wages is likely to generate more resistance from workers than an increase in wages less than the rate of inflation, the output loss associated with disinflation at low rates may be high. Fortin thus concludes that *"it would probably be optimal for the Bank to stop [disinflating] before reaching zero inflation, say perhaps around a 2 percent rate."*

Fortin's argument would seem to suggest that workers behave irrationally by reacting differently to a real wage cut depending on whether it takes the form of a money wage cut or a money wage increase less than the rate of inflation. At a minimum, more work is needed to explain why rational economic agents would react differently to an equivalent change in the real wage. In an empirical study of this issue, Cozier and Wilkinson (1990) examine different specifications of the Phillips curve and find no evidence that its slope is smaller at lower rates of inflation. More work is also needed to test for non-linearities in the Phillips curve at low rates of inflation.

Distribution

Redistributions of income accompany reductions in inflation. Lipsey (1990), for example, identifies two basic types of redistribution. First, not all regions of the country feel inflationary pressures to the same degree, yet all must bear the costs of disinflation. Second, anti-inflation policy, with its high short-term interest rates and high value of the Canadian dollar, tends to benefit lenders at the expense of borrowers and tends to benefit those who import goods and services at the expense of those who export.

But, as Lipsey points out, it is not possible to fight inflation selectively. Moreover, inflation eventually spreads out until it affects all regions. Thus the benefits from price stability are as widespread as are the costs of fighting inflation.

In addition, inflation itself generates redistributions of income and wealth that are probably more widespread and random than those associated with disinflation. Everyone on a fixed income, for example, loses from inflation. And everyone who is party to a contract written in money terms gains or loses every time the rate of inflation changes unexpectedly. Thus, it is not at all obvious that disinflation produces greater redistributions of income and wealth than does the presence of inflation itself.

Inflation as a tax

An alternative to direct taxation is for the government to print new money to finance its expenditures. Printing money creates inflation that acts indirectly like a tax on holders of existing money and other assets that have fixed money value. In effect, the government obtains goods and services because inflation reduces the purchasing power of the individuals who hold money assets. In this sense, inflation is a tax like any other.

Mankiw (1987), for example, suggests that it is desirable to use inflation to transfer resources to government, even though it causes distortions, because all taxes are distortionary to some degree. Income taxes, for example, reduce the incentive to work because leisure is not taxed equally. Corporate taxes reduce the incentive to invest. A principle in public finance theory — namely that the marginal distortionary costs of all taxes should be equal — would therefore suggest that inflation should be positive and should increase along with other taxes when there is a decision to increase the share of government consumption or investment in the economy.

There are a number of reasons why this argument might be wrong. The first is that inflation appears to be a relatively costly way to transfer resources to government. Evidence for the United States cited by Garfinkel (1989) shows that the marginal cost per dollar of revenue raised through seigniorage exceeds that for all alternative sources of revenue at all positive rates of inflation. Based on this evidence, it is never optimal to use inflation as a tax.

A second reason is that other taxes become even more distortionary as inflation rises, because the tax system is simply not designed to cope with inflation. Thus, lowering inflation not only reduces the direct costs associated with inflation, but makes other taxes less distortionary as well.

A third reason is that money is an intermediate good, and there is another principle in public finance that states that it is never optimal to tax an intermediate good.

Yashiv (1989) provides a fourth reason to reject Mankiw's analysis. He shows that when Mankiw's analysis is extended to include three

revenue-generating instruments (taxes, money and bonds), the optimal rate of inflation is independent of government revenue requirements because these requirements no longer affect intertemporal prices.[12] Rather, the rule derived by Friedman (1969) — where a small amount of deflation is optimal — is valid as a special case.

The trade-off between inflation and unemployment

The most popular argument for positive inflation derives from the premise that inflation and unemployment are negatively related in the long run and that permanently lower unemployment can be gained at the expense of permanently higher inflation. Since unemployment and inflation are both costly, the argument goes, society is better off with a mix of the two. This mix will involve a small, positive rate of inflation.

In the 1960s it was thought that a long-run trade-off between inflation and unemployment existed because workers would not seek full compensation for inflation. If inflation thus caused real wages to fall, increasing the profitability of firms, firms would hire more workers and increase output. This trade-off would last as long as wages did not catch up to prices, in other words, as long as inflation coaxed workers into accepting lower real wages.

The existence of a long-run trade-off between inflation and unemployment has been largely discredited in the economic literature on the grounds that workers cannot be continually 'fooled' by inflation. Eventually, wages catch up to prices and unemployment returns to its equilibrium or 'natural' level. Indeed, as inflation continues, more workers and firms take it into account in their wage settlements, causing wages to become even more responsive to inflation, and the short-run trade-off between inflation and unemployment disappears as well. Much empirical work has been done on this issue; it is clear that the consensus in the profession is that a long-run trade-off between inflation and unemployment does not exist.

[12] Mankiw bases his analysis on two instruments: taxes and money.

2.4 The distinctiveness of price stability

Price stability has several unique characteristics that add to its appropriateness as a goal for monetary policy — characteristics that give it the potential to be better understood, more readily accepted, and more easily maintained than other, more arbitrary inflation targets.

Price stability is clearly consistent with the basic mandate of a central bank — namely, to preserve the value of money. This gives price stability an intuitive appeal not shared by other goals. It also means that price stability is easy to understand as a goal of monetary policy because it clearly minimizes the costs of inflation — that is, it eliminates inflation as a consideration in economic decision-making.

Price stability has a psychological appeal that makes it different from other targets. In the words of Friedman (1985), "*Zero has a special appeal on political grounds that is not shared by any other number. Zero is — as a psychological matter — qualitatively different ... It is what has come to be called a Schelling point — a natural point at which people tend to agree.*"[13] In particular, price stability represents the middle ground in the theoretical debate over the optimal rate of inflation. Zero represents a natural compromise between the desire for a small, positive rate of inflation in order to avoid the cost of reducing inflation all the way to zero, and the desire for a small, negative rate of inflation in order to minimize the opportunity cost of holding money or to stabilize money wages.

Countries with low average rates of inflation tend to have more stable inflation as revealed by an absence of a significant upward trend. This 'stylized' fact is reflected in Table 2.1, where countries are ranked according to their average rates of inflation during the period 1961-87. Germany, for example, averaged 3.6 per cent inflation with no discernible upward trend in inflation. Countries with higher average rates of inflation, on the other hand, tend to have rising rates of inflation. Italy, for example, averaged 9.6 per cent inflation and had an upward trend in inflation of nearly one-half per cent per year. Thus,

[13] This reference is to the optimal growth of base money but applies equally well to inflation.

the closer an economy is to price stability, the smaller its upward trend in inflation — in other words, inflation is more stable at lower rates.[14]

Table 2.1

Inflation in Industrial Countries
1961-1987

Country	Average Inflation	Maximum Inflation	Standard Deviation of Inflation	Trend Inflation
Germany	3.6	7.0	1.9	0.00
Switzerland	4.0	9.8	2.3	-0.03
Austria	4.7	15.1	4.3	0.01
Luxembourg	4.8	10.8	3.0	0.13
Netherlands	5.1	10.5	2.7	-0.06
U.S.	5.2	13.5	3.4	0.18
Belgium	5.3	12.8	3.1	0.13
Canada	**5.7**	**12.4**	**3.3**	**0.24**
Japan	6.3	23.2	4.4	-0.13
Sweden	6.9	13.7	3.1	0.21
Norway	7.0	13.7	3.0	0.23
Australia	7.0	15.1	4.3	0.35
France	7.1	13.7	3.6	0.21
Denmark	7.6	15.2	3.0	0.08
Finland	7.9	17.8	4.2	0.13
U.K.	8.3	24.3	5.6	0.21
New Zealand	9.2	17.2	5.1	0.51
Ireland	9.4	20.9	5.8	0.29
Italy	9.6	21.3	6.3	0.45
Spain	10.7	24.5	5.4	0.30
Iceland	27.7	84.3	19.6	1.61

Another measure of stability is the standard deviation of inflation. The larger the standard deviation, the more volatile inflation is. A small standard deviation means that inflation has been relatively stable around its mean. The data in Table 2.1 also show that countries close to price stability tend to have smaller standard deviations and therefore smaller fluctuations in inflation. Countries far from price stability tend to have larger fluctuations in inflation. A basic message in the data is that no

[14] The trend in inflation is calculated by regressing inflation against time. The data are taken from the 1988 *IMF International Financial Statistics Year Book*.

industrialized country in the last twenty-five years has succeeded in maintaining high but steady inflation.

Table 2.2

Inflation and Growth Cycles 1962-87 (25 years)
G-7 Countries

Country	Inflation Maximum	Growth Minimum	Lag in Growth Trough
Canada	4.6% in 1969	2.5% in 1970	1 year
	10.9% in 1974	2.6% in 1975	1 year
	12.4% in 1981*	-3.4% in 1982*	1 year
United States	5.9% in 1970	-0.3% in 1970	0 years
	11.0% in 1974	-1.0% in 1975	1 year
	13.5% in 1980*	-2.5% in 1982*	2 years
Japan	7.6% in 1970	4.3% in 1971	1 year
	23.2% in 1974*	-1.4% in 1974*	0 years
	7.7% in 1980	3.1% in 1982	2 years
Germany	3.6% in 1966	-6.7% in 1968*	2 years
	7.0% in 1974*	-1.6% in 1975	1 year
	6.3% in 1981	0.2% in 1981	0 years
France	13.7% in 1974*	-0.3% in 1975*	1 year
	13.4% in 1981	0.7% in 1983	2 years
U. K.	24.3% in 1975*	-1.1% in 1974	-1 year
	18.0% in 1980	-2.1% in 1980*	0 years
Italy	6.7% in 1963	1.3% in 1965	2 years
	19.1% in 1974	-3.6% in 1975*	1 year
	21.3% in 1980*	0.2% in 1982	2 years

* Worst year in sample.

One reason why it is difficult to stabilize inflation at positive rates is that there will be a tendency to let inflation drift upwards in response to a shock. But once inflation is rising, it is necessary to tighten policy to prevent it from rising further. This approach puts a cycle into the economy that is very difficult to regulate, as is evidenced by the data in Table 2.2 where, almost without exception in the G-7 countries, cyclical inflation peaks have been followed by cyclical growth troughs. These cycles are a by-product of repeated attempts to stabilize inflation at positive rates. Moreover, countries with the higher peaks in inflation

tend to be those with the deeper troughs in economic activity. A policy of price stability would almost surely reduce the amplitude of these cycles.

3 ATTAINING PRICE STABILITY

The arguments and evidence presented in section 2 support the conclusion that price stability is the appropriate objective for monetary policy. But how should the path to price stability be established? In principle, the best path is one that maximizes the benefits from price stability while minimizing costs.

The fact that the benefits of price stability are large and long-lasting, while the costs of getting there are transient, suggests that price stability should be attained as quickly as possible. However, wages and prices are more rigid in the short run, suggesting that a gradual approach to price stability may be preferable. Moreover, it takes time for the monetary authority to establish credibility as an inflation fighter. The greater credibility is, the less costly the path to price stability because, with credibility, the plans of economic agents are consistent with the policy actions of the monetary authority.

3.1 Wage and price rigidities

Keynesian-type models, with their assumption of rigid wages and prices, predict that reducing inflation will be costly in terms of foregone output and higher unemployment.[15] Estimates from a Keynesian model by Ford and Rose (1989), for example, indicate that reducing inflation from five per cent to zero requires a cumulated unemployment gap of ten percentage points and a cumulated output gap of thirteen percentage points. The result follows from three features of the model. The first is an expectations-augmented Phillips curve, where a one percentage point gap between the unemployment rate and NAIRU exerts enough downward pressure on wages and prices to reduce inflation by 0.5 percentage points per year. The second is an Okun's Law equation where a one percentage point gap in unemployment corresponds to a 1.3 percentage point gap between actual and potential output. The third is that this year's inflationary expectations depend on last year's inflation outcome.

[15] Meyer and Rasche (1980), for example, find that Keynesian-type models have higher transition costs than the other mainstream models they looked at, namely monetarist models and rational expectations models.

The estimates from Ford and Rose can be used to show how faster approaches to price stability create greater fluctuations in economic activity even though the cumulated amount of foregone output is, by assumption, independent of the path taken. The gaps necessary to achieve price stability can be spread over three years, for example, resulting in large fluctuations in output, or spread out over ten years, resulting in milder fluctuations in output. In either event, the cumulated amount of foregone output is thirteen per cent, but inflation is slower to decline when the gaps are spread out over many years.

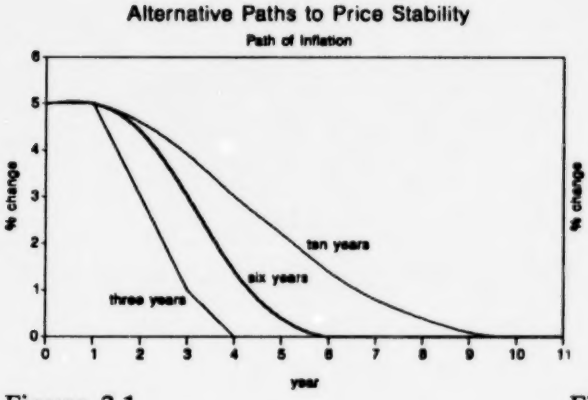

Figure 3.1

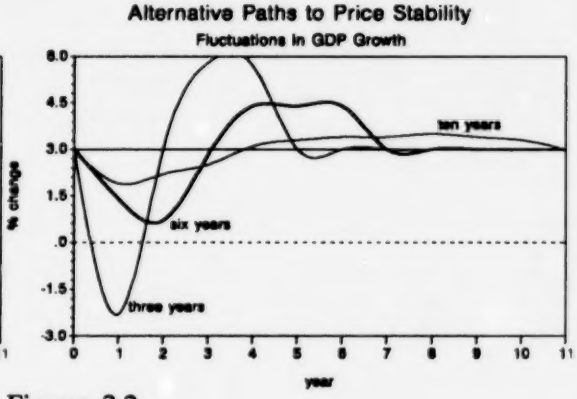

Figure 3.2

Figures 3.1, 3.2 and 3.3 illustrate different paths to price stability using the estimates from Ford and Rose. In each case, inflation is initially five per cent and the volume of output grows at three per cent per year. At the end of the simulation, output growth is again three per cent but inflation is zero.[16] The first path illustrates that attaining price stability in three years requires sizable but relatively short-lived output gaps such that the economy experiences a definite recession. Slower paths to price stability result in milder slowdowns in economic activity and smaller fluctuations in output.

[16] The simulations ignore the benefits from price stability that accrue in the form of higher potential because they are intended to illustrate different paths to price stability, not where those paths will eventually end up. In other words, potential output is held unchanged in these simulations.

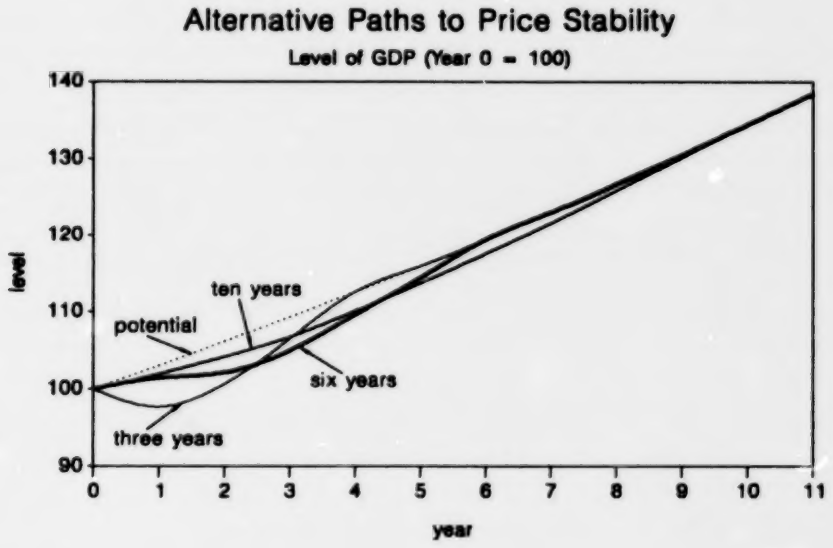

Figure 3.3

Taylor (1983) argues that three-year labour contracts are the main reason why wages are sticky in the short run. He looks at the distribution of workers by contract length and calculates the maximum speed at which inflation can decline without a significant rise in unemployment or without wage concessions in existing contracts. Taylor's results show that wages decline only gradually in the first two years of a disinflationary policy, then rapidly in the third year, and that by the end of the fourth year adjustment is complete.

The data in Table 3.1 also show that contracts in Canada today are longer on average than those in effect in Canada in 1981, suggesting that inflation could be slower to decelerate from current levels than was the case in 1981. The data in Table 3.2 support this contention, showing that inflationary expectations in the third year of a contract relative to those in the first year are higher on average today than they were in 1981. These data thus indicate that a gradual approach to price stability is appropriate.

If wages and salaries were more flexible — i.e., adjusted more quickly to changes in economic conditions — the costs of reducing inflation

would be lower. This result is evident in Table 3.3 where RDXF simulation results are used to illustrate the effect of greater wage flexibility. In the base version of RDXF, inflationary expectations are modelled as an eight-quarter moving average of past inflation. If, instead, wages were more flexible with inflationary expectations looking back only four quarters (i.e., modelled as a four-quarter moving average of past inflation), the costs of disinflation would be reduced with the sacrifice ratio dropping from 3.4 to 2.2.

Table 3.1

Proportion of Workers Covered by Major Union Contracts
by contract length

	Contract Length			
	1-year	2-year	3-year	Total
1989 Canadian data*	15.4%	33.1%	51.6%	100.0%
1981 Canadian data*	29.8%	54.7%	15.4%	100.0%
Taylor model	2.9%	20.7%	76.3%	100.0%

* Source: Labour Canada

Table 3.2

Contracted Wage Increase in Wage Settlement Data
by contract length
(per cent increase)

	1-year	2-year		3-year		
	contract	year 1	year 2	year 1	year 2	year 3
1989 Canadian data	5.8	6.6	5.7	4.9	4.7	4.4
1981 Canadian data*	5.8	6.1	4.6	6.9	5.0	3.2
Taylor model*	5.8	4.6	3.9	4.5	2.4	2.1

* Normalized so that the wage increase in a 1-year contract is 5.8%.

The reason why greater wage flexibility produces a lower sacrifice ratio in this class of model is that wage rigidity reflects the cost of learning about inflation. In other words, unemployment in these models acts as a signal to individuals to change their expectations about future wage and salary increases. The more rigid wages and salaries are (that is, the

longer it takes individuals to learn about a change in inflation), the more unemployment is necessary to convince individuals that it is appropriate to accept smaller increases in money incomes, and the more costly is disinflation. Conversely, the more flexible wages and salaries are (that is, the faster individuals learn about a change in inflation), the less unemployment is necessary to signal the appropriateness of smaller increases in money incomes, and the smaller are the costs of disinflation. In the limit, if everyone believed and acted as if the price level were stable from the beginning, the costs of disinflation would approach zero.

3.2 The importance of policy credibility

The second major assumption made by standard Keynesian models is that price expectations are backward-looking, so that economic agents must learn about policy by watching inflation fall — in other words, policy is not credible when announced. Only gradually do agents adjust their behaviour to adapt to lower levels of inflation.

A credible policy is one that conditions expectations in a forward-looking manner. Cukierman and Meltzer (1986) argue that announcing and explaining monetary policy serves to enhance credibility and thus reduces the cumulative output loss associated with attaining price stability. Simulations by the staff of the IMF (1990) illustrate the importance of this effect — the simulations show that the transitory costs of achieving price stability are reduced substantially through the gradual implementation of a pre-announced and credible program of cuts in money growth.

Table 3.3 highlights results from RDXF that show how different assumptions about policy credibility affect the amount of foregone output (as a percentage of GDP) necessary to reduce inflation by one percentage point. In general, the greater credibility is, the lower the costs of reducing inflation. Credibility is simulated by assuming that the objective of price stability and the time allotted to get there are announced at the beginning of the simulation period so that inflationary expectations become partly forward-looking. The weight on the forward-looking element of expectations is assumed to increase as the track record of declining inflation improves. In other words, credibility had to be earned by success in lowering the inflation rate. The effect of

introducing this change into the model is to reduce the sacrifice ratio from 3.4 to 1.7.

Table 3.3
Foregone Output from Reducing Inflation by a Percentage Point
Estimates from RDXF using different assumptions

Assumption	Sacrifice Ratio
Base model	3.4
Greater wage flexibility	2.2
Enhanced credibility	1.7

4 DEFINING PRICE STABILITY

Practical definitions of price stability must recognize that neither individual prices nor aggregate price indices can be prevented from changing in response to economic events. Indeed, the efficient working of markets requires that relative prices change in response to shifting conditions of supply and demand. Moreover, the economy cannot operate properly unless prices are flexible.

The obvious definition of price stability is therefore one where the general price level is allowed to fluctuate but always returns to a base value. If the price level had a base value of 100 sometime in the past, for example, this definition of price stability would imply that it will realize this base value again and again in the future — in other words, changes in the price *level* average to zero.

The problem with this definition of price stability is that it is not always appropriate for an aggregate price index to return to its base value. Aggregate price indices sometimes reflect changes in relative prices, for example, which are not necessarily inflationary. Other times, it might be appropriate to let the level of an aggregate price index change in order to smooth the impact of a shock to the economy.

An alternative definition of price stability has been proposed by Alan Greenspan (1989), Chairman of the United States Federal Reserve. He suggested that price stability is "*price levels sufficiently stable so that expectations of change do not become major factors in key economic decisions.*" Small amounts of inflation may be consistent with this definition of price stability as long as they are unobtrusive.

This definition of price stability would mean that any shock to the economy that was likely to trigger expectations of ongoing inflation would have to be identified and reversed. The shocks most likely to trigger such expectations are generalized demand shocks that push the economy beyond its capability to produce goods and services. Unfortunately, expectations are difficult to measure and shocks are difficult to identify. Moreover, it is difficult to determine what is a key economic decision and when it becomes distorted.

4.1 Measuring inflation

Inflation is a continuous rise in the *general price level* or, equivalently, a continuous fall in the value of money.[17] The general price level is the aggregate money price of all tangible and intangible goods and services purchased and sold in the economy. It includes the prices of real assets and it includes wages and other factor payments.

No price index corresponds exactly to what is meant by the general price level because no one index includes all money prices in the economy. Rather, price indices correspond to narrower economic concepts such as the price of the aggregate product of the economy or the price of aggregate consumption in the economy. Thus, no index covers as many prices, or as broad a range of prices, as prescribed by the concept of the general price level.

Since no price index corresponds exactly to what is meant by the term the general price level, one needs to monitor a variety of published price indices to gauge the true extent of inflation. Repeated upward movement in a majority of these indices would almost certainly be an indication of inflation. An increase in just one index, even if large and persistent, need not indicate inflation.

The gross domestic product (GDP) deflator is perhaps the most logical candidate for a price index to represent the general price level. The GDP deflator is the aggregate market price of all domestic production, excluding intermediate goods and existing assets. The GDP deflator includes the prices of public and private sector consumption goods and services, investment goods and services, and exported goods and services. It excludes the prices of all imported goods and services. The GDP deflator is a market price measure and includes indirect taxes.

The industrial product price index (IPPI) is another measure of goods produced in the Canadian economy but is less broadly based than the GDP deflator, covering only industrial goods.

The consumer price index (CPI) is also a candidate for a price index to represent the general price level. It includes the price of a

[17] This is the definition used by Laidler and Parkin (1975), for example.

representative basket of goods and services consumed in Canada whether they are produced here or imported. The CPI is different from the personal expenditure deflator (a subcomponent of the GDP deflator) in that the personal expenditure deflator is intended to measure the price of all consumer goods and services actually consumed in a given period, whereas the CPI is intended to measure the cost of living in Canada for a representative household. These two concepts are similar but not exactly the same. The difference is especially important when it comes to the treatment of some services, notably housing services. It is also important when it comes to fluctuations in car sales.

Other candidates to represent the general price level can be found on the factor payment side of the national ledger. Labour costs are the only factor payment measured comprehensively. (Profits and other factor costs tend to be measured residually.) There are three standard measures of aggregate labour costs — wage settlements, average earnings and labour income. None of these measures is entirely satisfactory as a measure of labour costs, however, as each suffers from one or more of the following deficiencies: (i) inadequate control for overtime hours, (ii) failure to include non-wage employee benefits, (iii) failure to control for employment shifts between industries, and (iv) failure to control for employment shifts between occupations.

What follows is a brief description of the qualities of the various price and wage measures mentioned above. All of these measures are widely available and relatively broadly based.

Variable-weight GDP deflator

The gross domestic product (GDP) deflator is designed to measure the price of the value added of domestically produced goods and services (including exports, excluding imports). It is constructed as the ratio of current period spending on Canadian goods and services to base period spending on the same basket of goods and services at the level of the major components.

The variable-weight GDP deflator thus uses current-period expenditure weights applied to the deflators of the expenditure components of GDP. There are about sixty expenditure components in all, including imports which are deducted from expenditures. Expenditure weights and prices appear in the deflator instead of production weights and prices because

of the focus in the national accounts on the expenditure side of the economy.

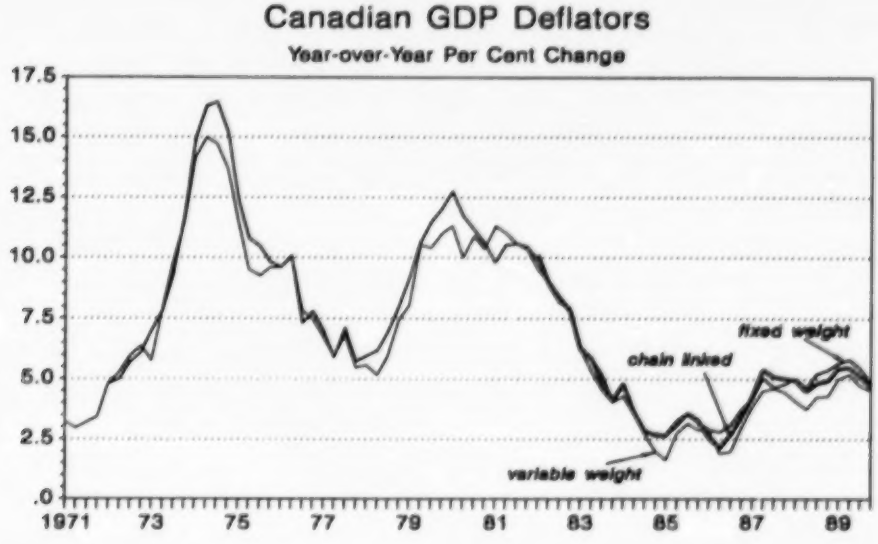

Figure 4.1

The component deflators that make up the GDP deflator are themselves based on fixed-weight aggregations of their subcomponents.[18] The weights represent the proportion of spending on the particular good or service subcomponent in 1981, the base year. The fixed weights mean that substitution bias is a problem for goods and services within subcomponents. The weights are updated only when major national

[18] The consumption deflator is a typical example of how the component deflators are constructed. Total consumption is defined as the sum of nine consumption components. Each consumption component has numerous subcomponents. The deflator for a consumption component is calculated as the weighted sum of the prices of the subcomponents. The weights on the subcomponents are the expenditure shares in the base year 1981. The constant-dollar value of a consumption component is then obtained by dividing the current-dollar value of the component by its fixed-weight deflator. The constant-dollar value of total consumption is just the sum of these constant-dollar components. The consumption deflator is then the ratio of current-dollar consumption to constant-dollar consumption. In other words, the consumption deflator itself has variable weights even though its component deflators are aggregates of fixed-weight deflators.

accounts revisions are undertaken.[19] Variable weights across the major components mean that the GDP deflator can be volatile, since it captures variation in weights as well as in prices. This does not seem to be a serious concern, however, as Figure 4.1 shows that the year-over-year changes in the variable-weight GDP deflator correspond closely to the changes in the fixed-weight and chain-linked indices (see below). Nevertheless, differences in month-to-month movements can be significant.

The GDP deflator is subject to quarterly, annual and periodic historical revision as well as to periodic rebasing. Although, in principle, GDP itself reflects new products as soon as money is spent on them, separate price indices for the new goods are constructed only when major national accounts revisions are carried out.

Fixed-weight GDP deflator

The GDP fixed-weight deflator is identical to the GDP variable-weight deflator except that it uses fixed weights to aggregate the major component deflators. The current weights are the expenditure shares in the base period 1981. The advantage of the fixed-weight index is that weight shifts between expenditure groups do not cause the index to move. Thus, the index is closer to measuring pure price movements.

Chain-linked GDP deflator

The chain-linked GDP deflator is arguably the best of the GDP deflators because it comes the closest to reflecting pure price movements. It is identical to the fixed-weight deflator except that the weights are updated every period to reflect the previous period's expenditure shares. As such, the change in the chain-link index between two adjacent quarters is a pure measure of price movements, using the most relevant weights.[20]

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[19] The base year of the national accounts has been updated every ten years in the past, but is expected to be updated every five years in the future.

[20] The quarterly chain-linked index uses the previous quarter's expenditure shares as weights. The annual chain-linked index uses the previous year's expenditure shares as weights.

Industrial product price index

The industrial product price index (IPPI) is designed to measure the aggregate price of the roughly 1300 major products sold by Canadian manufacturers. The price of each manufactured good is weighted by the share of the good in total manufacturing output as given by the input-output tables in the base year. Thus, the IPPI is a fixed-weight index.

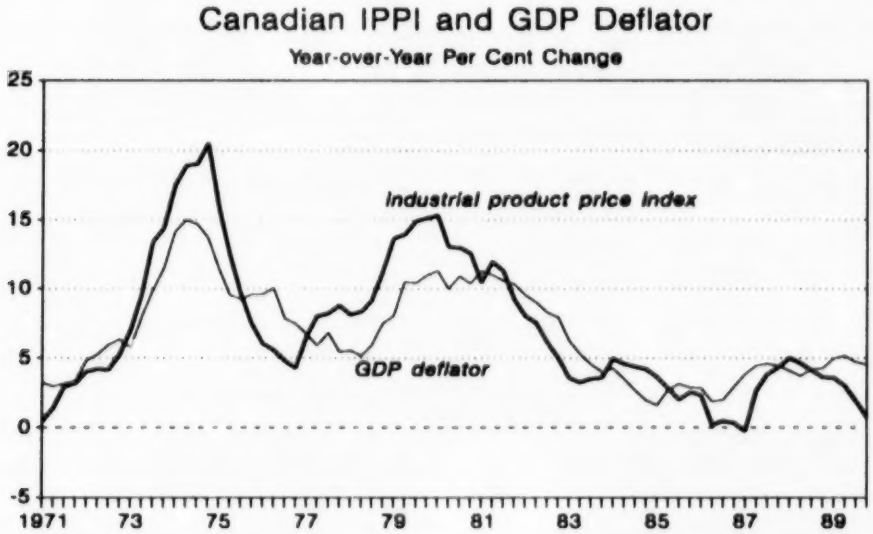

Figure 4.2

The IPPI includes products made wholly or partly from Canadian labour and materials and covers all sales to other Canadian businesses, individuals, governments and to non-residents. The index does not cover imported manufactured goods except those imported for resale by Canadian manufacturers. The IPPI thus has a narrower base than the GDP deflator and is therefore more volatile (Figure 4.2).

The prices covered by the IPPI are measured at the factory gate and do not include indirect taxes, transportation or other value added in distribution and sale. The effects of shifts in production patterns over time and the appearance of new goods in the economy are incorporated into the IPPI only when the input-output accounts are updated. The

IPPI is much narrower in concept than the general price level because it does not cover non-manufactured goods and services or transactions involving factors of production. Indeed, it has the narrowest coverage of any of the indices considered here. The IPPI is subject to revision up to six months after its release.

Consumer price index

The consumer price index (CPI) is designed to measure changes in the cost of living. It is a weighted average of the prices of an array of domestically consumed goods and services. The index includes the price of imported goods that are consumed in Canada and excludes the price of exported goods that are not consumed in Canada. The CPI represents the current price of a fixed basket of goods and services relative to the price of the same basket in the base period.[21] The contents of the basket are chosen to represent the average expenditures of a certain segment of the population at a certain time, and are updated every four years.[22] In principle, the basket contains goods and services of unchanged quality and quantity so that changes in the index reflect only pure price movements. The seasonally unadjusted data for the CPI are never revised.[23]

The majority of prices used to construct the consumer price index are collected in retail stores and outlets by Statistics Canada. The frequency with which prices are collected depends on the nature of the good or service. Prices of food and gasoline, for example, are collected twice a month. Most other prices are collected monthly. Some prices, such as those for furniture and cars, are collected less frequently. The CPI makes allowances for 'sale' prices since the intent of the index is to reflect average transaction prices.

The consumer price index is narrower in concept than the GDP deflator because it does not contain the prices of investment goods or exports of

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[21] The base period for the consumer price index, starting with the release of the June 1990 data, will be 1986.

[22] The latest basket updating took place with the release of the January 1989 CPI data where the 1982 basket was replaced by the 1986 basket.

[23] The seasonal factors used in calculating the seasonally-adjusted measures are revised annually with the release of the January CPI.

goods and services. Moreover, the index covers only goods and services with prices that can be associated with identifiable quantities and quality. Public goods and services provided through general taxation are excluded from the index because they do not have a price. Certain types of insurance premiums, such as disability insurance, are excluded from the index as is the price of health insurance. Property taxes used for educational purposes — which, strictly speaking, do not measure a price — are included in the index since they are considered an integral part of the cost of owning a house.

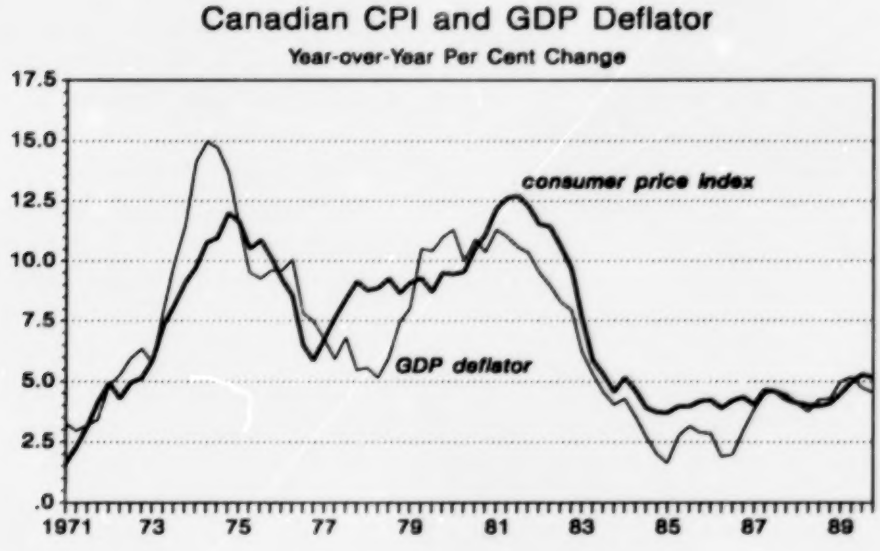

Figure 4.3

The CPI moves differently from the GDP deflator whenever the terms of trade (the price of exports relative to the price of imports) change or the price of investment goods change (Figure 4.3). Commodity prices have an important influence on the terms of trade in Canada, and the rise in commodity prices in 1973-74 is one reason why the consumer price index grew more slowly than the GDP deflator through this period. Flat commodity prices through 1977-78 help explain why the CPI grew faster than the GDP deflator during that period. The declining price of computers, an important component of the price of

investment goods in Canada, helps explain why the CPI grew faster than the GDP deflator through most of the 1980s.

Expenditure shares are used to weight the individual prices included in the CPI. The expenditure shares are obtained from the family expenditure survey and the family food expenditure survey conducted every four years, the most recent being 1986. The target population for the survey is private households located in cities with population greater than 30,000 (as well as Whitehorse and Yellowknife).

The fact that the weights of the consumer price index change infrequently means that the CPI suffers from *substitution bias*. Substitution bias occurs when actual expenditure patterns vary in response to changes in relative prices, so that the change in the cost of a fixed bundle of goods and services overstates the true increase in the cost of living because the measure ignores the substitution by consumers towards cheaper and away from more expensive products. Substitution bias in the CPI is thought to have been particularly important in the mid-seventies, when the energy crisis prompted a substitution away from fossil fuels to other less expensive and more efficient forms of energy. Over the long sweep of history, however, the substitution bias is not large. Généreux (1983) estimates that the substitution bias added an average of 0.1 percentage points to the CPI through the period 1957 to 1978.

New goods are introduced into the consumer price index only when they show up in the family expenditures surveys. From the time the new good is introduced into the market until it shows up in the survey, the good receives a zero weight in the CPI. This delay in introducing new goods into the index is known as the *new-goods bias*. The new-goods bias is particularly acute in areas such as home electronics, where prices can fall rapidly just after a good is introduced into the market. However, the bias cannot be that large since new goods, by definition, make up only a small proportion of consumer expenditures when they are first introduced. Fortin (1990a), using extreme assumptions, puts an upward bound on the new-goods bias of 0.4 percentage points per year.

Quality improvement is another important source of price adjustment. Enhancements to goods and services almost always result in higher prices. Yet from an economic point of view, an increase in quality

represents an increase in quantity, not price. Fortunately, the major published price indices are adjusted for quality change.

The consumer price index, for example, is adjusted for quality change by measuring the increase in cost associated with producing the higher quality product, or by linking the product to one that is not experiencing the increase in quality, or by sampling an item both before and after the improvement in quality and then using the resulting ratio to adjust for quality on a permanent basis. As a result, the *quality bias* in the consumer price index is probably small. Indeed, Triplett (1971), after surveying empirical studies on the problem of quality error in the American consumer price index, concludes that their CPI is just as likely to suffer from downward bias as from upward bias.

Net-price index

The net-price index (NPI) is the CPI net of indirect taxes. It is scheduled to be published for the first time in the fall of 1990. The index is thus a derivative of the consumer price index, having the same weights and the same coverage. It is therefore subject to the same biases and measurement problems as the CPI. Unlike the CPI, however, the NPI will be subject to revision whenever the indirect tax data are updated. The input-output system will be the source of the detailed indirect tax data.

Wage settlements

Wage settlements data are published quarterly by Labour Canada. The data are based on collective agreements in all industries in Canada that apply to 500 or more employees.[24] Subaggregates are available for workers in the public and the private sector, as well as for employees in commercial and non-commercial industries.

The wage settlements data are designed to measure changes in the 'base rate' of wage contracts. This is defined as the lowest-paid classification used for qualified workers in the bargaining unit.

[24] Agreements in the construction industry were not included in the index prior to 1983.

Estimates of cost of living adjustments (COLA) are included in the aggregate where applicable. Estimates of these payments are made by first quantifying the characteristics of the COLA clause in each agreement, and then calculating the COLA effect using the actual and projected increases in the CPI for the life of the contract. The projections are revised as the actual CPI becomes available.

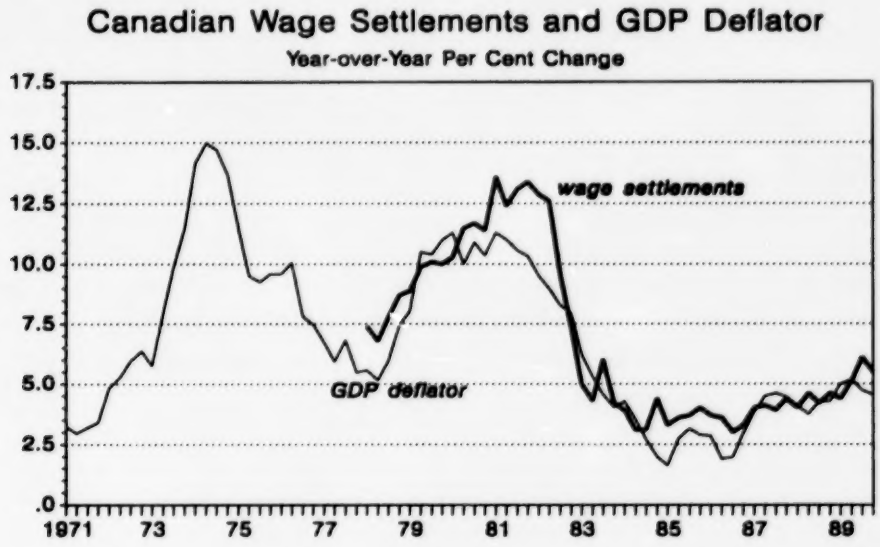

Figure 4.4

The wage settlements data have some limitations for use as a measure of aggregate labour costs. One limitation is that the settlements data are collected only for the unionized sector of the economy. Non-union workers are excluded from the aggregate.[25] A second limitation is that only new settlements are included in the measure of wage increases. New settlements are not uniformly distributed throughout the year, nor are they necessarily representative of the employment structure of the economy.

[25] In 1989, 36.2 per cent of non-agricultural paid workers were unionized.

In general, however, changes in the wage settlements data have tended to coincide with changes in the GDP deflator (Figure 4.4).

Earnings

The survey of employment, payrolls and hours (SEPH) is used to produce a fixed-weight measure of the change in the earnings of salaried and hourly paid employees. The survey is conducted monthly with about 70,000 reporting units, each a subdivision of an employment establishment. The survey is stratified such that firms with over 200 employees remain in the survey while other, smaller, firms rotate in and out of the survey. The survey covers all industries (except agriculture, fishing, private households, religious organizations and military services) and all regions of the country.

The survey covers employees drawing pay for services rendered and for whom the employer is required to submit a T-4 form. The self-employed, unpaid family workers, owners of unincorporated businesses and any worker who does not obtain pay directly from an employer are excluded from the survey.

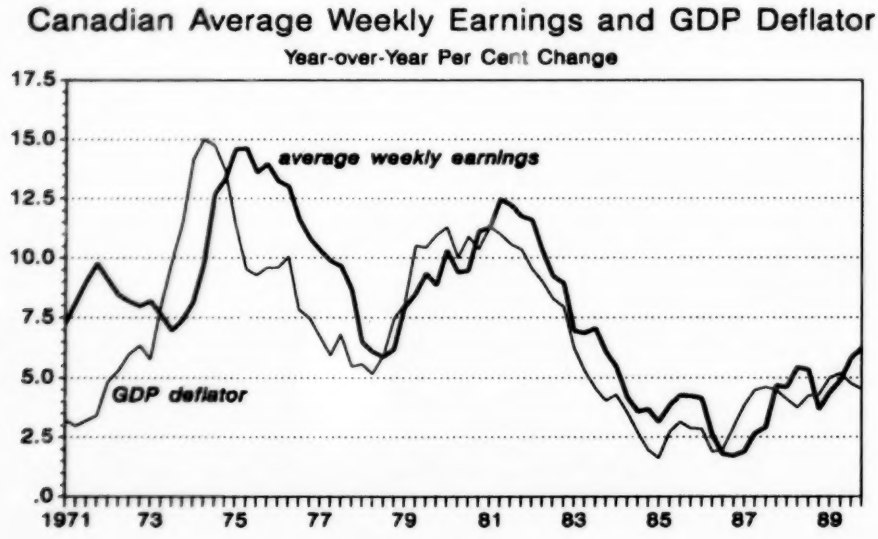

Figure 4.5

Earnings are defined to include gross pay before deductions but exclude supplementary labour costs such as employer contributions to unemployment insurance. Earnings obtained from strike funds or from compensation boards are also excluded. Data on overtime earnings and overtime hours are reported separately from regular earnings and regular hours.

The SEPH data on earnings is the most comprehensive labour-cost measure in Canada. Nevertheless, there are problems with using the data to gauge inflation. In particular, special factors and weight shifts tend to make the data volatile (Figure 4.5).

Labour income

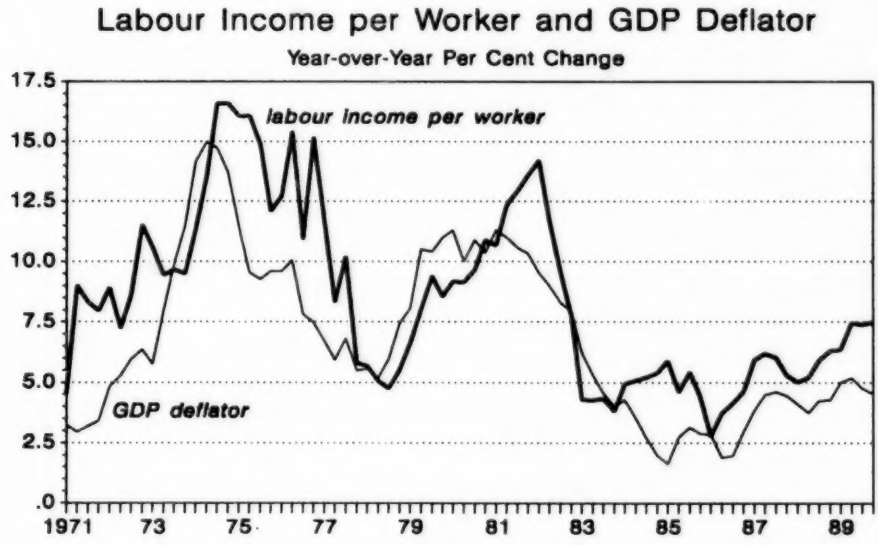

Figure 4.6

The labour income data are published monthly by the Labour Division of Statistics Canada and are the basis for the estimate of labour income in the national accounts. Labour income is comprised of the wages, salaries and supplementary labour income paid to workers residing in

Canada. A labour-cost measure can be calculated by dividing labour income by the number of workers.

The data for labour income are generated from benchmarks based on tax returns and projectors based on SEPH data. Data for supplementary labour income are derived from benchmarks based on administrative and survey data.

The main problem with the labour income data as a yardstick for inflation is that the data are not published on a timely basis and are subject to large revisions. Month-to-month movements in the data are difficult to interpret as they may be due to either a change in wage rates or a change in employment. One of the main puzzles concerning these data is why labour income per worker from SEPH data is smaller than labour income per worker from tax records. The labour income data must reconcile the differences between these two data sources.

4.2 The best measure for price stability

The characteristics of the various price and wage measures described above suggest that a practical definition of price stability would establish base-line *levels* for the CPI, the NPI, and the chain-linked GDP deflator. These three price indices are the preferred candidates because they are all broadly based, widely available, and provide good-quality price information. The IPPI is ruled out because of its narrow coverage. The chain-linked index is preferred among the GDP deflators because this measure tends to provide the maximum amount of price information.[26] The wage measures are ruled out because of the low quality of the wage data in terms of a pure measure of labour costs.

The advantage of focussing on not just one but several price indices reflects the fact that the measures constitute, by construction, different coverage and composition of the prices in the economy. This feature of the indices implies that they respond differently to different types of shocks. Indeed, the base-line levels of the price indices would in all likelihood need to be adjusted from time to time to reflect changes in certain types of relative prices — such as changes in the terms of trade

[26] See Hill (1988) for a good, but technical discussion of the properties of different types of price indices.

and indirect taxes — that have differential effects on the various price indices.

Stabilizing the CPI, for example, would imply that the GDP deflator would deviate from the CPI whenever the price of exports increased or decreased relative to the price of consumption goods and services, or whenever the price of investment goods and services increased or decreased relative to the price of consumption goods and services. Whenever indirect taxes increased the NPI would remain unaffected, whereas both the CPI or the GDP deflator would reflect the impact of the increase in taxes on final prices.

In the same manner, stabilizing the GDP deflator would imply that the CPI or the NPI would deviate from the deflator under certain circumstances. Thus, the advantage of focussing on more than one index is that the reasons for a deviation from a base-line level would have to be identified. All indices, for example, would be affected by a generalized demand shock. In the case of an increase in indirect taxes, however, the NPI would not be directly affected and in this instance might provide a better guide as to whether inflationary pressures had mounted.

Over time the growth rate of these indices should converge to provide similar measures of inflation. Persistent and growing deviations between the indices and their base-line levels would be incompatible with price stability.

5 CONCLUSIONS

The purpose of this paper was to review the issues surrounding price stability as a goal for monetary policy. Issues of particular concern to the operation of monetary policy were highlighted.

Section 2 of the paper reviewed the basic case for choosing price stability as the goal of monetary policy. The case rests on the benefits of a trustworthy monetary standard. The issue is how to identify and quantify the benefits of such a standard, and to contrast these with the costs of achieving it. Although more work is needed to quantify the benefits and costs of price stability, the available evidence does suggest that the benefits of price stability are many and large while the costs are transitory and small by comparison.

Section 3 reviewed the issues surrounding the choice of a path to price stability. The particular issue raised is whether the approach to price stability should be fast or slow. It was illustrated that progress towards price stability is easier, and therefore can be traversed more quickly, when wages and prices are flexible and when the monetary authority has credibility. More work is needed in this area.

Section 4 discussed issues involving the definition of price stability and the measurement of inflation. Price stability was defined where the changes in the price level average to zero. This does not mean that individual prices cannot change. It was concluded that no published price index is 'best' at measuring inflation. In practice, one must rely on an array of price indices to determine when inflation is present. This reflects the fact that the different price indices provide different perspectives on inflation because of their different coverage and composition.

REFERENCES

Angell, Wayne D. "The Case for Price Stability." Remarks before Forex, USA Inc., 15 February 1990.

Blanchard, Olivier J., and Lawrence H. Summers. "Hysteresis and the European Unemployment Problem." In *NBER Macroeconomics Annual 1986*, edited by Stanley Fischer. Cambridge, MA: MIT Press, 1986.

Burns, Andrew. *Unemployment in Canada: Frictional, Structural and Cyclical Aspects*. Economic Council of Canada, Working Paper No. 1, 1990.

Coe, David T. "Structural Determinants of the Natural Rate of Unemployment in Canada." *International Monetary Fund Staff Papers* 37 (March 1990):94-115.

Cozier, Barry. "Real Wages in Canada: An Analysis of Recent Trends." *Bank of Canada Review*, November 1989.

Cozier, Barry, and Gordon Wilkinson. *How Large are the Costs of Disinflation?* Bank of Canada Working Paper, forthcoming.

Crow, John. "The Bank of Canada and Its Objectives." *Bank of Canada Review*, April 1987.

_____. "The Work of Canadian Monetary Policy." *Bank of Canada Review*, February 1988.

_____. "Remarks to a Symposium on Monetary Policy Issues in the 1990s." *Bank of Canada Review*, September 1989.

_____. "Targeting Monetary Policy." *Bank of Canada Review*, December 1989.

Cukierman, Alex, and Allan H. Meltzer. "The Credibility of Monetary Announcements." In *Monetary Policy and Uncertainty*, edited by Manfred M. Neumann. Baden-Baden, Germany: Nomos Verlagsgesellschaft, 1986.

Feldstein, Martin S. "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy." *Journal of Political Economy* (August 1979):746-67.

Fischer, Stanley. "Towards an Understanding of the Costs of Inflation: II." In *The Costs and Consequences of Inflation*. Carnegie-Rochester Conference Series on Public Policy, v.15, 1981.

Fischer, Stanley, and Franco Modigliani. "Towards an Understanding of the Real Effects and Costs of Inflation." *Weltwirtschaftliches Archiv* 114 (1978):810-833.

Ford, Robert, and David Rose. *Estimates of the NAIRU Using an Extended Okun's Law*. Bank of Canada Working Paper 89-3, November 1989.

Fortin, Pierre. (a) "Do We Measure Inflation Correctly?" In *Zero Inflation: The Goal of Price Stability*, edited by Richard G. Lipsey. Ottawa: C.D. Howe Institute, 1990.

_____. (b) *Can Canadian Anti-Inflation Policy be Made More Cost Effective?* Centre de recherche sur les politiques économiques, Université du Québec à Montréal, March 1990.

_____. "Credit Crunches and Wage Dynamics: A Revision of the Canadian Phillips Curve, 1957-1987." Paper presented at the Third Annual Conference of the Canadian Macro Study Group, Queen's University, Kingston, Ontario, November 1989.

Friedman, Milton. "The Optimum Quantity of Money." In *The Optimum Quantity of Money and Other Essays*. Chicago: Aldine, 1969.

_____. "The Case for Overhauling the Federal Reserve." *Challenge* 28 (July/August 1985):4-12.

_____. "The Resource Cost of Irredeemable Paper Money." *Journal of Political Economy* 94 (June 1986):642-647.

Garfinkel, Michelle R. "What Is an 'Acceptable' Rate of Inflation? - A Review of the Issues." *Federal Reserve Bank of St. Louis Review* 71 (July/August 1989):3-15.

Généreux, Pierre A. "Impact of the Choice of Formulae on the Canadian Consumer Price Index." In *Price Level Measurement: Proceedings from a conference sponsored by Statistics Canada*, edited by W.E. Diewert and C. Montmarquette. Ottawa: Supply and Services Canada, 1983.

Gilson, Stuart C. *The Inflation-Adjusted Rate of Return on Corporate Debt and Equity: 1966 - 1980.* Technical Report No. 39. Ottawa: Bank of Canada, April 1984.

Greenspan, Alan. "Statement by Alan Greenspan, Chairman, Board of Governors of the Federal Reserve System before the Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, 24 January 1989."

Hill, Peter. *Recent Developments in Index Number Theory and Practice.* OECD Economic Studies No. 10, Spring 1988.

Howitt, Peter. "Zero Inflation as a Long-run Target for Monetary Policy." In *Zero Inflation: The Goal of Price Stability*, edited by Richard G. Lipsey. Ottawa: C.D. Howe Institute, 1990.

International Monetary Fund. *World Economic Outlook — Prospects and Policy Issues.* Washington, D.C.: International Monetary Fund, April 1990.

Jarrett, J. Peter, and Jack G. Selody. "The Productivity-Inflation Nexus in Canada, 1963-1979." *The Review of Economics and Statistics* 64 (August 1982):361-67.

Lacroix, Robert, and François Dussault. "La Grève: Ses Facteurs Déterminants et Son Effet Sur les Hausses de Salaire. Une Synthèse Critique." *L'Actualité Economique* 4 (October-December 1979):545-567.

Laidler, David, and J. Michael Parkin. "Inflation: A Survey." *The Economic Journal* 85 (December 1975):741-809.

Leijonhufvud, Axel. "Costs and Consequences of Inflation." In *Information and Co-ordination.* New York: Oxford University Press, 1980.

Lipsey, Richard G. "The Political Economy of Inflation Control." In *Zero Inflation: The Goal of Price Stability.* Ottawa: C.D. Howe Institute, 1990.

Lipsey, Richard, G. ed. *Zero Inflation: The Goal of Price Stability.* Ottawa: C.D. Howe Institute, 1990.

Mankiw, Gregory N. "The Optimal Collection of Seigniorage: Theory and evidence." *Journal of Monetary Economics* 20 (1987):327-341.

McCallum, John. "Les Taux de Chomage Canadien et Américain dans les Années 1980: Un Test de Trois Hypotheses." *L'Actualité Economique* 64 (December 1988):494-508.

Meyer, Laurence H., and Robert H. Rasche. "On the Costs and Benefits of Anti-Inflation Policies." *The Federal Reserve Bank of St. Louis Review* 62 (February 1980):3-14.

Novin, Farid. *The Productivity-Inflation Nexus Revisited: Canada 1969-1988.* Bank of Canada Working Paper, forthcoming.

Purvis, Douglas D. "The Bank of Canada and the Pursuit of Price Stability." In *Zero Inflation: The Goal of Price Stability*, edited by Richard G. Lipsey. Ottawa: C.D. Howe Institute, 1990.

Rose, David. *The NAIRU in Canada: Concepts, determinants and estimates.* Technical Report No. 50. Ottawa: Bank of Canada, 1988.

Taylor, John B. "Union Wage Settlements During a Disinflation." *The American Economic Review* 73 (December 1983):981-1010.

Triplett, Jack E. "Determining the effects of quality change on the CPI." *Monthly Labor Review*, U.S. Department of Labor Bureau of Labor Statistics, May 1971.

Yashiv, Eran. "Optimal Inflation and the Government Revenue Mix." *Economics Letters* 31 (December 1989):151-154.